Adaptive Control of Amplitude Distortion Effects

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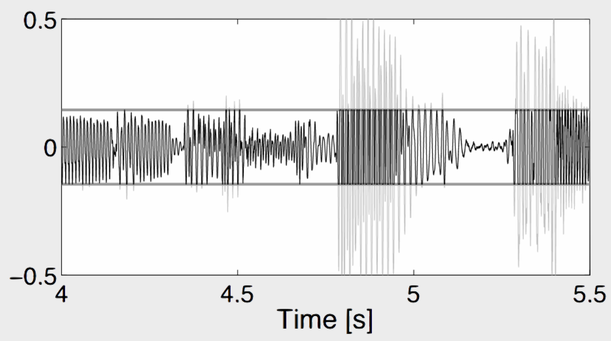
1 Introduction

- Amount of distortion proportional to input level for most implementations
- Needs careful, manual setting of gain or threshold controls for different input signals and varying levels
- Evaluation of distortion effect that scales the transfer function with moving average of signal level
- Member of adaptive audio effects (A-DAFx) and suitable for use in autonomous mixing systems



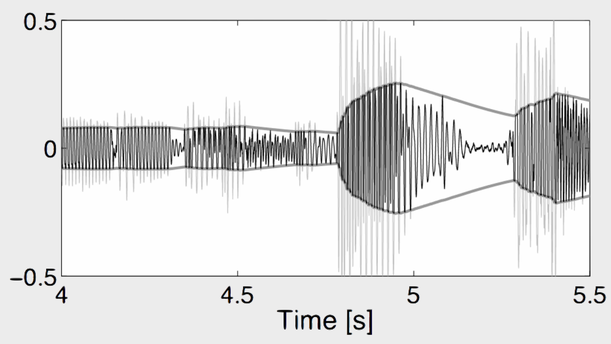
Varying input level causes high variation of distortion, and a drastic reduction of the dynamic range (hard clipping with static threshold)

2 Threshold automation

Transfer function scaled by exponential moving average of RMS level

$$L_{RMS}[n] = \sqrt{(1-\alpha)\cdot x^2[n] + \alpha \cdot L^2_{RMS}[n-1]}$$

with x the input signal, and $\alpha = \exp\left(\frac{-1}{\tau \cdot f_s}\right)$ where τ is the characteristic time constant and f_s the sampling rate.

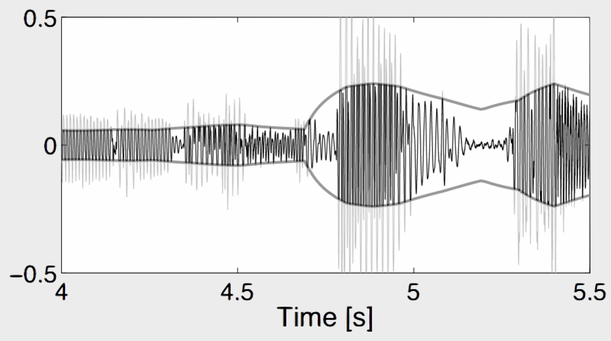


Scaling of hard clipping threshold with moving average of RMS input signal level

3 Threshold automation with lookahead

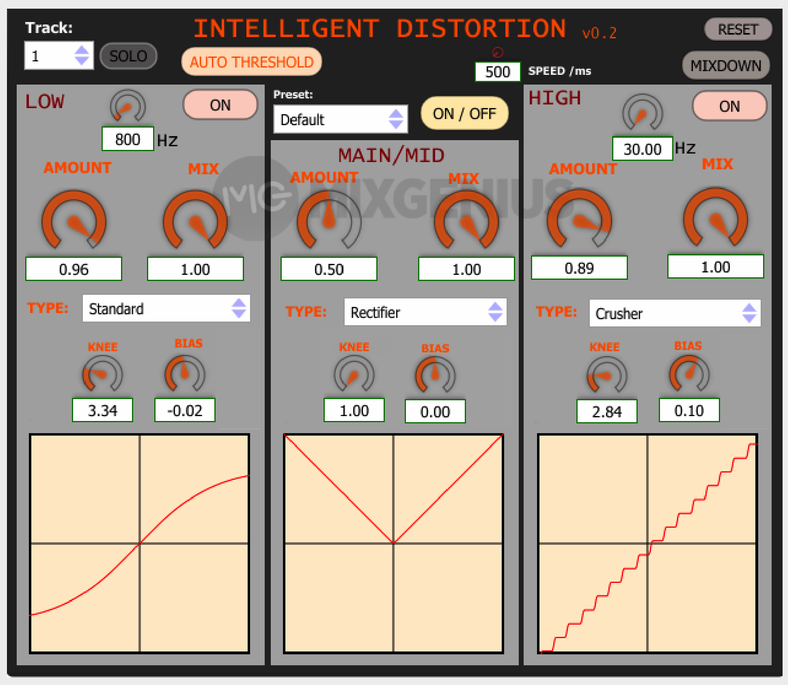
Transfer function scaled by

$$L_{rms}[n] = \sqrt{\begin{array}{l}(1-\alpha)\cdot \max\left(x^2[n], x^2[n+1], ..., x^2[n+L]\right) \\ \quad + \alpha \cdot L^2_{rms}[n-1]\end{array}}$$



Added lookahead functionality to accommodate sudden changes in signal level

4 VST plugin



Multiband VST plugin based on the proposed algorithm

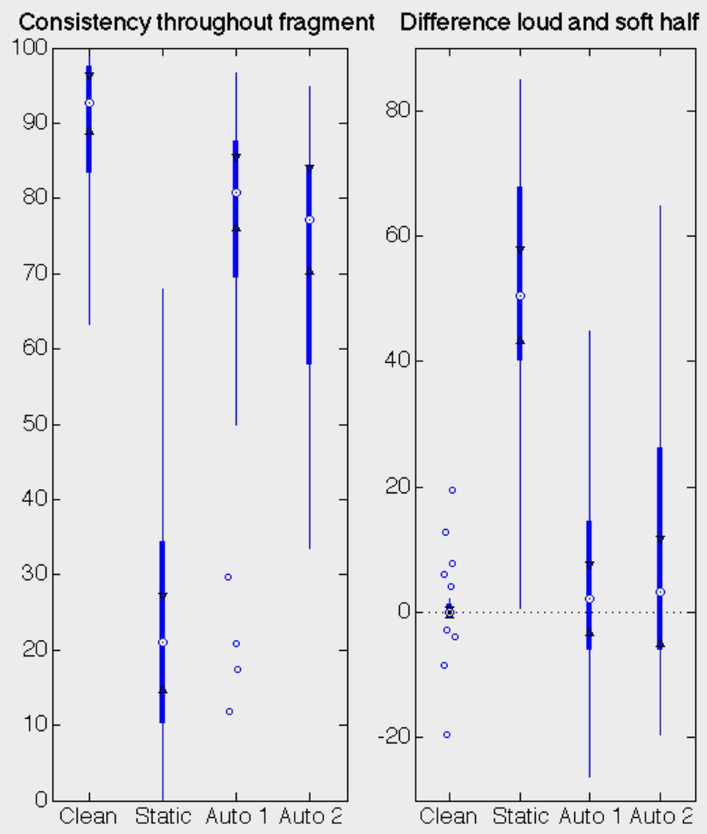
5 Further automation

Make-up gain: RMS level or loudness normalisation to compensate for trimmed signal peaks

Anti-aliasing: upsampling ratio based on Nyquist frequency, type of distortion, signal content, and/or user input

Subband gain: approach certain target power per subband (e.g. automatic exciter)

6 Perceptual evaluation



Clean No distortion applied
Static Static distortion applied
Auto 1 Threshold automation
Auto 2 Threshold automation with lookahead

- Four real-word test signals (vocal, Rhodes piano, bass guitar and drums) with artificial 10 dB boost halfway through fragment
- Perceptual evaluation with N = 9 participants
- Perceived amount of distortion consistent
- No significant difference between *Auto 1* and *Auto 2* (lookahead)